This article was published in the Spring 2022 Analyst. Copyright 2022, published by the Association of Water Technologies (AWT). It is reprinted with permission at hcinfo.com. This article may not be copied and/or distributed electronically or in paper form without permission of AWT. For more information about *The Analyst*, visit <u>www.awt.org</u>. How Changes in Water Management Programs Could Present New Opportunities for Water Treaters

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New opportunities for water treaters could be just around the corner. Water Management Program (WMP) performance data and trends indicate changes may be needed in the strategy for reducing the risk of *Legionella* and other pathogens in building water systems, and that water treaters will be instrumental in the implementation of the improved strategies.

Water treaters already have a leading role in ASHRAE Standard 188 (1) WMPs—setting up water management plans for facilities, collecting samples tested for *Legionella* or other pathogens, and providing remediation equipment and services. Changes needed to improve the performance of WMPs will allow water treaters to expand their contribution to public health and grow their businesses.

#### Keys to WMP Success in Reducing Risk

If the premise of ASHRAE Standard 188 is sound, then fully implementing a comprehensive WMP will reduce the risk of legionellosis. Many facilities claim to have a WMP, but how many of them are *comprehensive* and *fully implemented*?

Control measures determine the degree of comprehensiveness and implementation. To reduce the risk of disease caused by *Legionella* and other pathogens in building water systems, steps must be taken to control growth and transmission factors such as temperature, chemistry, flow, and biofilm. Control measures are thus the most important element of WMPs. The purpose of all other WMP elements—flow diagrams, list of team members, risk/hazard analysis, verification procedures, and validation methods—is to support the development and implementation of effective control measures.

Control measures must be included for all water systems and devices that present a significant risk. Measures for those devices must be specific, effective, and implemented. Such a monitoring program is designed to show whether each control measure has been adequately implemented, while WMP validation indicates the effectiveness of all control measures for a given system.

#### **Facility Compliance**

Even if the premise of ASHRAE 188 is sound, the standard will never significantly reduce legionellosis unless a high percentage of facilities fully implement a comprehensive WMP. Out of the total number of facilities that should have a WMP per the risk factors outlined in ASHRAE 188, the percentage that have developed a comprehensive WMP is unknown and difficult to determine based on a simple survey, in part because, if asked, some facilities would report having a comprehensive WMP—probably in good conscience, believing they do—when in fact they have policies rather than control measures, or control measures that are ineffective, inadequate, or nonspecific.

According to research funded by the Water Research Foundation (2), the percentage of facilities with comprehensive WMPs is likely very low. Only 50% of education and hospitality facility managers surveyed had heard of ASHRAE 188. Awareness was even lower among multifamily facility managers—less than 30% knew that domestic (potable) water systems have conditions favorable to *Legionella* growth or had even heard of water management plans.

Since the percentage of facilities that have comprehensive WMPs is unknown, we attempted to answer a different question, one for which we have data to study: *Of the facilities that have comprehensive WMPs, what percentage are fully implementing them?* 

# Data Analyzed to Determine WMP Implementation and Effectiveness

To determine the degree to which facilities that have comprehensive WMPs are implementing them, the following metrics were analyzed for WMPs that had been active in a cloud-based WMP software application<sup>A</sup> for at least 12 months as of June 16, 2021:

- Control Measure (CM) compliance, based on the percentage of CMs with "OK" (i.e., up-to-date) verification status. It is reasonable to assume the facilities had comprehensive CMs based on the software's defaults, but a limitation of this study is that WMP teams could have deactivated some of the software's default CMs that apply to their facilities, making their WMPs less than comprehensive.
- Number of *Legionella* and other microbial tests.
- Number of domestic water temperature and disinfectant tests.

The above metrics were compared with domestic water Legionella positivity.

#### Control Measure Compliance

Only 19% of the 908 WMPs that qualified for the study had CM verification compliance of greater than (>) 80% (Table A). Since some facilities may not be using the software's CM verification tool, the percentage was calculated also for facilities with CM compliance > 0%. Even in the unlikely scenario that all facilities with 0% compliance were not using the cloud-based software's verification tool, still only one-third of remaining group had CM verification compliance > 80%.

CM Compliance %OK*	% of All Sites**	% of Sites with CM OK% > 0	
0	41.96%	N.A.	
0.5-49%	26.43%	45.54%	
50–79%	12.44%	21.44%	
80–94%	9.69%	16.70%	
95–100%	9.47%	16.32%	
	100.00%	100.00%	
Notes:		·	

\* As of the end of the study period, rather than the average over the life of the WMP.

\* Excluding WMPs activated for less than 12 months.

### Domestic Water Legionella Tests

Only 264 sites (29%) had recorded Legionella test results for domestic (potable) water, and of those, only 153 sites (17%) had recorded results in the recent 12 months.

Since at least 10 samples are typically needed from domestic water systems, the number of results recorded per site in the recent 12 months (Table B) indicates fewer than 10% of the properties were sampling more than twice yearly.

Table B: Domestic Water Legionella	7 Test, Results Recorded
in Recent 12 Months	

Legionella Tests in Recent 12 Months	Sites	Percentage of Sites	
0	755	83%	
1–9	31	3%	
10–19	36	4%	
20–39	36	4%	
40+	50	6%	
		100%	

#### Comparison of CM Data and Legionella Positivity

Facilities with higher CM compliance generally performed more tests for Legionella, other microbes, temperatures, and disinfectants than did facilities with lower CM compliance (Table C). In short, facilities that kept up with their control measures also performed more tests.

Importantly, Table C also indicates facilities that implemented control measures and performed tests were likely to have lower Legionella positivity. Legionella positivity was not considered for the 0% CM compliance group because that group's number of Legionella tests was too low to make a reliable comparison. For all other groups, the average domestic water Legionella positivity decreased with increasing CM compliance and generally with increasing numbers of temperature and disinfectant tests.

CM Compliance % OK*	Legionella**	Other Microbial**	Temperature**	Disinfectants**	Legionella % Positive in DW ***
0	0.81	0.14	1.44	2.98	NA
0.5–49%	5.62	2.21	8.18	12.05	24.03%
50–79%	7.21	1.54	33.99	7.95	21.40%
80–94%	17.36	7.82	26.77	32.50	16.88%
95–100%	33.16	23.67	51.53	33.84	14.98%

Table C: Comparison of CM Compliance With Number of Tests and Domestic Water Legionella Positivity in WMPs Active > 12 Months

Notes:

\*As of the end of the study period, rather than the average over the life of the WMP.

\*\* Average number of tests in recent 12 months.

\*\*\* For the life of the WMP, excluding sites with fewer than six domestic water test results total.

A limitation of this study is that some facilities may have performed tests for *Legionella*, other microbes, temperatures, or disinfectants without recording the results in the cloud-based WMP software, but that would not likely affect the trends shown in Table C.

#### Implications of the Performance Data

The data outlined in Table C indicates that the premise of ASHRAE Standard 188 is sound—implementing comprehensive control measures can reduce domestic water *Legionella* positivity.

The reality is, however, that a very low percentage of facilities are fully implementing comprehensive WMPs, which is likely why reported cases of legionellosis have not decreased since ASHRAE Standard 188 was released. If WMPs were required by law in more states, or by insurance carriers for liability policies, a much higher percentage of facilities would develop WMPs. However, since enforcing full implementation of comprehensive control measures is not feasible, such requirements will not likely be enough to significantly reduce cases of waterborne illness caused by domestic water systems.

What could really move the prevention needle is requiring WMPs and making them easier. Busy facility personnel—like all of us—are more likely to do what does not take much time, effort, money, or expertise.

Automation is the key to making WMPs easy but effective. Automated monitoring, alerts, reporting, documentation—and to some extent even remediation—will require less time by facility personnel and less help from outside experts. As technologies improve, an increasing number of the key WMP elements—control measures, monitoring, and remediation—will ideally become fully automated and continuous.

Automated monitoring would make WMPs more protective. As someone who wants to lower their blood sugar levels will be more conscience of their eating habits if they test their levels daily, facilities need frequent test results to be motivated to implement control measures. Seeing inadequate test results for temperatures, disinfectants, water age, or other parameters will make applicable control measures or corrective actions climb their priority list.

#### Supplementing Legionella Testing

Monitoring parameters that can be measured continuously, automatically, and inexpensively can fill in gaps left by the following limitations of *Legionella* testing:

- 1. Most facilities are unable or unwilling to devote the time and money needed to perform an adequate number of *Legionella* tests (Table B).
- 2. With current technologies and cost, *Legionella* testing cannot be performed automatically or frequently. Getting test results only once or twice a year, or even monthly, is not enough.
- Legionella tests alert facilities of Legionella but not to factors that lead to its growth. If the sampling and laboratory analysis are performed properly, Legionella test results show the cumulative and combined effect of various factors, such as temperatures, disinfectant levels, flow, and biofilm, as well as system design. Seeing the "bottom line" for various factors is important, but for effective prevention, facilities must frequently monitor key factors instead of waiting months between Legionella tests to find out the cumulative and combined effect of them. This aligns with ASHRAE 188 and CDC recommendations (3–5) to monitor Legionella growth factors.
- 4. *Legionella* tests do not alert facilities to conditions caused by incidents such as water main breaks or water pressure shock that, if not effectively managed, could result in pathogen growth or release.
- 5. Few individuals have the expertise and objectivity to respond to *Legionella* findings with remediation that effectively reduces the bacteria without overspending, damaging equipment, or increasing another hazard.

#### The Next Steps

Water treaters will likely have a key role in the steps needed to make WMPs easier and more effective:

 Studies to correlate pathogens to parameters that can be measured continuously, automatically, and inexpensively. Much is known about the effect of temperatures and certain disinfectants on *Legionella*. Studying relationships between various pathogens and additional parameters will provide opportunities to gather more data points for a fuller picture. Data sharing and collaborative research can reduce the time needed to find such correlations.

- Water-related artificial intelligence technologies and improved sensors to automate continuous monitoring of parameters.
- Implementation of Internet of Things (IoT) in smart domestic water system equipment to make automatic adjustments based on parameter readings.

In the years to come, water treaters will still help facilities set up WMPs. The water treaters with knowledge about automation technologies will have a greater role, helping their customers make WMPs easier and more preventive. 🏷

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#### Endnote

<sup>A</sup> LAMPS is a cloud-based WMP software application developed and provided by HC Info.



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